THERAPEUTIC LOW LEVEL LASER APPARATUS AND METHOD

This application claims the benefit under 35 U.S.C. § 119(e) of the U.S. provisional patent application no. 60/401,103 filed August 5, 2002.

Technical Field

The present invention relates to therapeutic lasers, and more particularly to a method and apparatus for programmable, multi-frequency, multi-wavelength low level laser therapy.

Background Art

Any living cell in a biological system requires energy for normal metabolism, function, and repair. When injury or sickness occurs, normal metabolism, function, and repair is impaired. The addition of energy delivered directly to damaged areas can aid in the return of normal function.

United States Patent No. 4,930,504 to Diamantopoulos et al. discloses a therapeutic device with a cluster probe connected to a control box. The cluster probe has laser, superluminous and light emitting diodes that emit steady or selectively pulsed radiation in multiple wavelengths to enhance the depth of delivery of energy within the tissue. United States Patent No. 4,951,663 to L'Esperance, Jr. discloses a sterilization device with two laser beams with the phase shift and polarization angle being adjustable between the beams. L'Esperance, Jr. does not suggest any specific beneficial phase shift or

polarization angle. The "Resonator" and the "Rotary Multiplex", Low Level Lasers, Inc., are therapeutic devices with a combination of laser and light emitting diodes of multiple wavelengths that are pulsed. The "Rotary Multiplex" includes an increasing pulse frequency program and can be factory reprogrammed.

Disclosure of the Invention

Therapeutic low level laser apparatus includes a housing, a diode array, control electronics connected to the diode array, and a power source, means for operator input and means for operator output, connected to the control electronics. The diode array has four sets of laser diodes arranged symmetrically about the center of the array, and four pairs of light emitting diodes arranged between the sets of laser diodes. Each set of laser diodes includes first, second and third laser diodes arranged in an equilateral triangle and oriented such that the planes of the linear beams are approximately 120 degrees to each other, intersecting at the center of the triangle. The first, second and third laser diodes emit light of a selected first, second and third wavelength, respectively. The pairs of light emitting diode are arranged in opposed locations about the center of the array and each pair of light emitting diodes emits light of a selected different frequency. The control electronics are programmable and activate the diode array, controlling power output and pulse frequency of each laser and light emitting diode. The therapeutic low level laser method includes providing apparatus that emits a beam of three selected wavelengths of laser light and four selected wavelengths of light emitting

diode light, pulsing the beam pursuant to a selected frequency sequence, and exposing tissue to the beam.

Brief Description of the Drawings

Details of this invention are described in connection with the accompanying drawings that bear similar reference numerals in which:

Figure 1 is a front elevation view of apparatus embodying features of the present invention.

Figure 2 is a back elevation view of the apparatus of Figure 1.

Figure 3 is a sectional view taken along line 3-3 of Figure 1.

Figure 4 is a diagrammatic view of the diode array of the apparatus of Figure 1.

Detailed Description Of The Invention

Referring now to Figures 1 to 3, therapeutic low level laser apparatus embodying features of the present invention includes a housing 11, a diode array 12, control electronics 14, an electric power source 15, a means for operator input 16 and a means for operator output 17. Housing 11 is generally elongated, has a front 20 and a back 21, and is preferably sized and shaped to be comfortably held in the hand of an operator. Other sizes and shapes are suitable for housing 11.

The diode array 12 is substantially planar and is mounted in a recessed manner in the back 21 of the housing

11. The diode array includes four each first, second and third laser diodes 1, 2 and 3, and two each first, second, third and fourth light emitting diodes 4, 5, 6 and 7 that, in the illustrated embodiment, emit the following wavelengths:

1 = 650nm laser diode
2 = 780nm laser diode
3 = 808nm laser diode
4 = 660nm light emitting diode
5 = 880nm light emitting diode
6 = 470nm light emitting diode
7 = 940nm light emitting diode

As shown in Figure 4, the first, second and third laser diodes 1, 2 and 3 are arranged in four sets 23, with one set 23 at each of 45, 135, 225, and 315 degrees about the center 24 of the diode array 12. Each set 23 is arranged as an equilateral triangle with the first laser diodes 1 each an equal first distance from center 24 and the second and third laser diodes 2 and 3 an equal greater second distance from center 24. The first, second and third laser diodes 1, 2 and 3 of each set 23 are oriented at 120 degrees to each other, as indicated by the lines through the first, second and third laser diodes 1, 2 and 3 in Figure 4, with the first laser diodes 1 being oriented along lines through center 24. The first, second, third and fourth light emitting diodes 4, 5, 6 and 7 are arranged in a cross formation between the sets 23 with equal wavelengths being mirrored or opposed across center 24.

Referring again to Figures 1 to 3, the control electronics 14 and power source 15 mount in the housing 11 with the power source 15 connecting to and powering the control electronics 14. The power source 15 is preferably a

rechargeable storage battery and is preferably rechargeable without removal from the housing 11. The control electronics 14 connect to and provide electric power to diode array 12 to individually activate and control the intensity of each of the first, second and third laser diodes 1, 2 and 3, and each of the first, second, third and fourth light emitting diodes 4, 5, 6 and 7. The control electronics 14 include current monitoring to assure precise intensity control. The control electronics 14 can pulse each of the first, second and third laser diodes 1, 2 and 3, and each of the first, second, third and fourth light emitting diodes 4, 5, 6 and 7 at a frequency of from about 0.1Hz to 300kHz in 0.01Hz increments.

The control electronics 14 is programmable and, in the illustrated embodiment, includes three preprogrammed modes:

Mode 1: Frequency = 50Hz, duration = 3 minutes, power = all lasers set at 1 to 4 mW.

Mode 2: Frequency = 7.83Hz, duration = 3 minutes, power = all lasers set at 1 to 4 mW.

Mode 3: Frequency = see below, total duration = 3 minutes, power = all lasers set at 1 to 4 mW.

1. 17.16 sec - 4.3 Hz
2. 5.72 sec each for 28 increments that increase from 4.7 Hz to 130.2 Hz.

The means for operator input 16 is connected to the control electronics 14 and in the illustrated embodiment includes an on/off button 27, a function button 28 and a mode button 29. Other means for operator input 16 are

suitable, such as additional buttons, a keypad, or a jack for connection to a keyboard or a personal computer.

The means for operator input 16 also includes a jack 30 for connection of a calibration device that allows the manufacturer to calibrate the diode array 12 and to download operation modes such as listed above. The jack 30 may also be used by an operator to download new modes. By way of example, and not as a limitation, the calibration device may be a personal computer. The means for operator output 17 is mounted on the front 20 of housing 11, connected to the control electronics 14 and, in the illustrated embodiment, includes a mode indicator 32, a battery indicator 33 and a time remaining indicator 34.

The first, second and third laser diodes 1, 2 and 3, and the first, second, third and fourth light emitting diodes 4, 5, 6 and 7 emit beams normal to the plane of the diode array 12. The configuration of the diode array 12 provides four "hot spots" where the beams of the first, second and third laser diodes 1, 2 and 3 overlap. Due to the "Soliton Phenomenon", where multiple overlapping waveforms create unique wave structures capable of imparting effects unattainable with individual waveforms, improved penetration into tissue is provided.

The method of the present invention includes the steps of: providing a diode array with sets of first, second and third laser diodes that emit at wavelengths of about 650nm, 780nm and 808nm, respectively, with the beams of the first, second and third laser diodes oriented at about 120 degrees relative to each other and overlapping, pulsing the first, second and third laser diodes at a selected frequency

sequence and projecting the resultant beam on the tissue. The first, second and third laser diodes may be pulsed according to the above described modes as well other modes.

Although the present invention has been described with a certain degree of particularity, it is understood that the present disclosure has been made by way of example and that changes in details of structure may be made without departing from the spirit thereof.